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MYCOSPHAERELLA SENTINA (FUCK.) SCHOET.: OCCURRENCE OF THE PERITHECIAL STAGE IN ITALY AND OBSERVATIONS RELATIVE TO ITS BIOLOGY *

I have observed on numerous samples of pear leaves attacked by pear scab (*Venturia pirina* Aderh.) another infection, abundant and widespread, due to *Mycosphaerella sentina* (Fuck.) Schroet. This observation encouraged me to continue investigations on this latter disease so as to furnish some knowledge on the biology of its causal agent in Italy.

There are wide gaps in the bibliographical data on this subject, particularly in regard to environmental conditions in Italy and to some of the morphological and systematic characteristics of the fungus which even today are somewhat indefinite.

The specific agent of this disease of the pear, known in Italy under the common name of 'seccume fogliare estivo' (summer leaf shriveling), was first described from two contradictory versions. One by DESMAZIÈRES (1834) which described under the name of *Depazea piricola* a species with slightly olive hued conidia issuing from the pycnidium as cirri of an olive-white colour (cirrhi albidi, spermatia jalina), and the other by FUCKEL (1869) who described a *Septoria nigerrima* with hyaline conidia forming cirri deep black in colour (cirrhi aterrimi, spermatia jalina). Later, ALLESCHER (1850), KRIEGER (1869), SACCARDO (1884), etc. in view of the absence of other differential characteristics, considered the two fungi as being identical, because in both cases the investigators found a sameness in shape and dimensions of the conidia, which fact led them to give them the name of *Septoria piricola* Desm.

Already since 1904 KLEBAHN has proved by experiments the existence of the metagenetic relations between *Sept. piricola* and *Myc. sentina*, perfect stage of the parasite. The life cycle of this interesting fungus thus was defined.

In Italy, FERRARIS (1936) in reporting the preoccupying spread and intensity of attack of 'seccume fogliare estivo' in Piedmont, traced, by means of the studies and data acquired by the preceding investigators, a diagram of

* Communication from Dr. GINO FLORENZANO of the Royal Observatory of Phytopathology (Plant Pathology Section), attached to the Royal Institute of Plant Pathology at Florence, presented by Prof. CESARE SIBILIA, Director of the aforesaid institutions.

the biology of *Myc. sentina*. He stressed the importance of checking this fungus in order to prevent the damage increasing from year to year, caused to the foliage of some particularly susceptible varieties of pear.

Recently SOLAROLI (1942) renewed, under the supervision of Prof. SIBILIA, observations on the conidial stage and carried out experiments on germination in culture of conidia taken from leaf lesions. He also carried out investigations on certain epidemiologic aspects of the disease without, however, extending his observations to the perithecial stage of the causal agent.

It is evident, therefore, that there is a complete lack of definite data on the life of the specific parasite of 'seccume fogliare estivo' during the rest period in our orchards. This gap appears all the more serious in view of what is known now, namely, that only the perfect stage may be considered as capable of ensuring from year to year the early contamination of pear-trees.

During the month of April, 1943, on some dead pear-tree leaves which had been sent to me from Montalto Pavese, Pavia Province, I observed, besides the perithecia of *Vent. pirina*, other perithecia which differed decidedly from the former, not only in anatomical morphological characteristics, but also by a slight slowness in development compared with *Vent. pirina* which had already been in the stage of emitting ascospores for some days. Other material which had been sent me from San Pietro di Carrù, Cuneo Province and Piozzo, Turin Province on May 4 following, as well as from Santa Caterina di Rocca d'Arazzo Asti Province, confirmed what I had previously noted, with the difference that the perithecia, foreign so to speak to this investigation, were also ripe and in the ascospore emission stage. These conditions greatly simplified the description and systematic differentiation of the fungus.

It was a question of ripe perithecia ascribable to *Myc. sentina* which on microscopic examination presented the following characteristics :

Mycosphaerella sentina (Fuck.) Schroet.

The perithecia which, on maturity, have a globular form, are numerous, in groups and rarely isolated, localized chiefly on the upper surface of the leaves but also on the lower surface and developed in the middle of greyish spots, up to 7-9 mm. broad. They are found under the epidermis which is raised and perforated by their hemispheric extremity, showing under the magnifying glass as a small black point on the surface of the leaf ; black, 95 to 130 μ broad, with a beak-shaped ostiole, easily seen when the epidermis is raised. The wall of the perithecium which has a thickness of 9 to 13 μ, is formed of 3 to 4 layers of cells with very thick, dark brown membranes. These perithecia contain numerous asci enclosing 8 spores; they are club-shaped and irregularly concave, the membrane is colourless and they are 50 to 70 μ long by 10 to 13 μ broad. The ascospores, in two indistinct rows, are slightly curved, hyaline, obtuse at the extremity and divided by a partition into two perfectly equal cells ; they measure 24 to 30 μ in length by 3 to 4 μ in breadth.

During the same period, the same facts were reported on material taken direct from a locality (San Gaggio) near Florence, and the observation of KLE-

BAHN on the simultaneous presence, on winter pear-tree leaves, of *Vent. pirina* and *Myc. sentina*, was repeated.

I was not satisfied with these preliminary observations and desired to direct my investigations towards elucidating the conditions governing the evolution of the perithecial stage starting from the lesions made in the leaf by the conidial form and collecting the greatest possible number of positive data capable of contributing effectively to the interpretation of factors essential to the development of epidemics of 'seccume' and to the implicit indication of the means suitable for checking the disease.

During the summer of 1943, after June 21, date when the characteristic white spots appeared on many pear-trees on the hills around Florence (although the first report of 'seccume' attack was of an earlier date, occurring in the orchard of the horticultural farm of the Royal Agricultural Technical Institute of Florence), infection increased to a remarkable extent and intensity, even though in Tuscany, the drought and heat of the season had greatly limited grape downy mildew (*Plasmopara viticola* (Bork. et Curt.) Berl. et de Toni) attack and even scab infection.

Consequently this investigation was undertaken by starting from the conidial stage and the observations made on the numerous samples obtained in different localities of the Province of Florence concerned essentially the external and microscopic characteristics of the leaf lesions with a view to establishing the eventual relations existing between the type and extent of these lesions and the production of perithecia.

On the living leaves the characteristic grey or chestnut-coloured lesions are easily seen, they are transparent, rounded or polygonal in shape, from 1 to 3 mm. broad, at first isolated, later joining together in a more advanced stage, clearly delimited on the surface of the leaf and surrounded by a dark brown halo. In the centre of the spots, small black points subsequently appear varying in number from 5 to 15 per spot; they are rather prominent, scattered and visible on both surfaces of the leaf, but chiefly on the lower surface. These small points represent the fructifications of the conidial stage. These are generally considered as the pycnidia as they constitute the most widely differentiated form of conidial fructification, as they are completely surrounded by a wall and empty out of a regular opening of a specific shape.

Under the microscope these pycnidia show a rounded or globular shape and are 130 to 140 μ wide by 90 to 115 μ long. They are found entirely under the epidermis of the leaves which is raised and torn at maturity by the terminal opening of the fructifications for the emission of the conidia.

A pseudo-tissue girdles externally the cavity of the pycnidium, but it does not have the aspect of a true tegument as it blends in colour and shape with the cells of the mesophyll which seem to be compressed by fructification. From this pseudo-tissue very clearly originate the conidia about 10 μ long and 1 μ broad which are particularly numerous on the under part of the pycnidium. The conidia are long, falciform, irregular, tricellular and also bicellular, subhyaline and measure 45 to 55 μ × 2-2.5 μ.

I frequently found that some thalli of *Septoria* did not differ greatly from

the acervuli of a Melanconiaceous fungus and that the said wall is not formed constantly and in a sufficiently marked and evident manner. This would indicate once again how artificial and deprived of natural value is the limit traced, for the Deuteromycetes group, by systematists, between conidial stages with wall and those without. Likewise the number of spore and conidia cells has proved that it was not a decisive element to show the metagenetic correlations.

The affected leaves present, as infection spreads, a uniform chestnut brown colour, at the bottom of which, however, it is still possible to identify, delimited as they are by a darker line, angular light spots. When the leaves are in this state they fall to the ground at different periods, causing the formation of dark grey spots more and sometimes much more extensive than those due to conidial infection. A fact of this kind ought evidently to be placed in relation with the expansion, in the leaf tissue, of the fungus which begins, from this moment, a new phase in its life cycle. The leaves which in September presented this general type of lesion, already fallen to the ground, show no traces, under the microscope, of elements resembling stromas, but only here and there, rather thick hyphae, slightly browned.

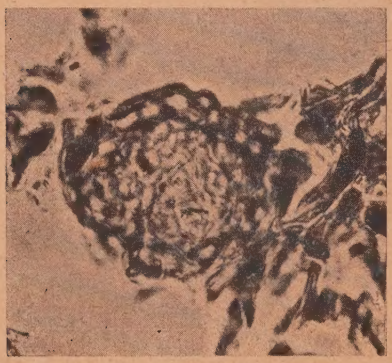

FIG. 1. — Rough outline of perithecium *Mycosphaerella sentina*, in the ascogonial phase (× 680) (original)

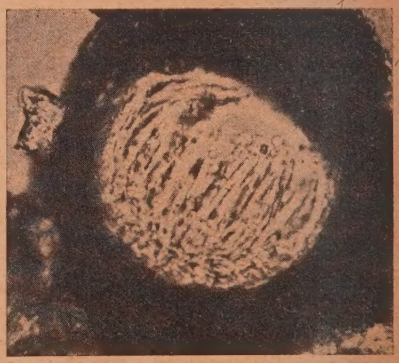

FIG. 2. — Mature perithecium of *Myc. sentina*, in emission phase (× 450) (original)

Unfortunately, having been absent from Florence following the first days of September 1943, I was not able to make a detailed study of the subsequent progress of the fungus on the limb of the leaves fallen from the trees and the data collected during summer have not been further examined. None the less, it had been found that the first emission of ascospores from the samples obtained near Florence had taken place in a moist chamber at an environmental temperature between May 2 and 10.

Investigations were only renewed in January, 1944 with fresh material obtained direct from different localities near Vibo Valentia, Catanzaro Province where, through the kindness of the Rector of the local Commercial Technical Institute, I was allowed to make use of a modest laboratory of Natural Sciences and a good microscope. The dead leaves collected were put into a sack

and placed in such a way as to pass the winter in the open, and from time to time I took samples for microscopic examination.

The first sections of wintering leaves effected on January 10 showed that the fungus was in the epidermal cells and also to a small extent in the palisade tissue while after this date, the fungus penetrated more into the leaf tissue, even when throughout the month of January no phenomenon was observed which might have indicated the beginning of perithecium formation. On February 19 microscopic examination revealed the presence of small knots formed by a supple intertwining of chestnut-coloured hyphae, which in the successive preparations assumed the aspect of small bodies delimited externally by thick walls and of which the internal tissues are light. A differentiation more decided than the previous identification, necessarily summary, considering the research equipment at my disposal, was subsequently noted (March 10) in the collection of the same date and origin : the dark corpuscles, in cross-section, showed an aperture 40 to 50 μ wide in which were numerous very fine thin filaments. In the mesophyll, the hyphae were much less frequent than in January; they were characterized by sudden changes in calibre and by the practically complete lack of brown colouring at certain points. A rare lateral diffusion of hyphae in the limb was observed.

The successive stages of perithecial evolution are easily identifiable if account is taken of the regular increase in diameter and the typical progressive differentiation of the content of the perithecia, despite the frequent observation of the delayed appearance of perithecia within the same relatively homogeneous collection. In this respect, the promordia of new perithecia continue over a fairly long period (25-30 days), producing on the same leaf, the superposition of different stages of development, from the earliest up to the last, with the relative periods of transition.

By tracing, from preliminary research results, the typical development of perithecia of *Myc. sentina*, the stages through which the hibernation of the parasite advances can be specified and indicated, pending more detailed cyto-histological studies which will enable the phenomena observed to be explained and defined more clearly :

FIG. 3. — Characteristics of white spots of *Septoria piricola* on living pear leaf : the under surface of the leaf is shown (original)

I. — First appearance of a perithecial primordium characterized by an interlacing of hyphae coiled up like a small irregular ball of string : — ascogonial phase;

II. — Differentiation of a pycnidium with dark external walls, in which the cavity shows an indistinct light tissue, where very numerous thin hyaline ascogenous filaments form : —

filamentous phase;

III. — Development of asci from ascogenous hyphae : —

ascus phase;

IV. — Appearance and delimitation of the first ascospores : —

ascospore phase;

V. — First escape of ascospores observed in moist chamber : —

emission phase.

The development of these phases up to full maturity of the perithecia requires a period of 55 to 65 days according to the complex variability with which the ecological factors influence the biology of the fungus.

The first mature perithecia of *Myc. sentina* which I was able to observe in Calabria on May 7, 1944, after a particularly severe and rainy winter, began to emit spores only after May 19 although they had been kept under favourable moisture conditions and at a temperature which did not go below 12° C.

The mature perithecia corresponded perfectly to the first description made in 1943.

The observations which were continued in December 1944 and during the first half-year of 1945 at the Royal Phytopathological Observatory in Florence and which could not be extended nor made more exhaustive, even from another point of view, were limited to the pursuit and confirmation of the preceding data.

The first rudiments of perithecia were already evident towards the middle of January, 1945, contrary to the previous year ; also the report of mature *Myc. sentina* dates, for some orchards in Tuscany, from April 15, and the first emission of ascospores was obtained after May 5, by observing control leaves placed for the purpose in an orchard close to the town.

The results of this preliminary study and the first definite report of the perithecial stage of *Myc. sentina* in Italy may represent accurate data which may serve to direct on biological bases the control of the ' seccume fogliare estivo ' of the pear. This disease, despite the little importance given it by fruit-tree growers, becomes more serious every year, not only in the South as SOLAROLI points out, but also in North Italy as noted by FERRARIS. It reduces the vitality of pear-trees and adversely affects yield. In fact, I observed for the first time in Calabria and also in 1945 at Florence, direct attack on the fruit by the conidial stage (*Sept. piricola*) in association with *Fusicladium pirinum*. This latter observation, after the confirmation of a frequent possibility of simultaneous co-existence on pear-tree leaves of *Vent. pirina* and *Myc. sentina*, has conferred on this problem the necessity of elucidating and studying thoroughly, more so than by earlier investigators, the relations existing between these parasitic fungi.

It should be pointed out first of all that in the life cycle of *Myc. sentina* two phases ought to be distinguished : (1) the parasitic phase which takes place on the living leaves, still attached to the tree, and sometimes sporadically on the fruit on which *Sept. piricola* forms white spots amidst the scab lesions ; (2) the saprophytic phase which occurs in winter on the leaves fallen to the ground, and which are marked with white spots and about to disintegrate.

FIG. 4. — Lesions due to 'seccume' on a leaf in an advanced stage of wintering (under surface of the leaf) (original).

The summary epidemiological survey made over a period of three years, although not under homogeneous conditions, contributes towards completing the biological data of KLEBAHN in relation to Italian conditions of environment and makes it possible to establish that there is a close correlation between the saprophytic phase and the parasitic phase according to the period and intensity of development of the disease after the first infection of the season. At all events, the wide and complex variability of biological factors and environment has not by any means been properly investigated, and a detailed study of these factors is of great importance for data for elaborating an effective and sure protection program (preventive and extinctive), even under unfavourable conditions.

Moreover, the ensemble of observations collected shows how, for *Myc. sentina*, the perfect stage, in the absence of other known winter forms for this parasite, ensures primary infection of the pear-trees and marks the parasitic phase of the life cycle of the fungus. The impressive number of perithecia with which the surface of the winter leaves seem to be literally covered, represents a quantity of germs rapidly active and capable also of provoking early and mass infection, lasting for a fairly long period, as a result of the maturation verified and not simultaneous of the perithecia.

Moreover, the projection of ascospores is possible in an atmosphere sufficiently humid to render the leaves bearing the perithecia, supple and flexible, even if they are not directly softened. It suffices, in effect, to place in a damp room, under a slide, a fragment of leaf covered with ripe perithecia, to be able to observe after a few hours, at a temperature of 18 to 19° C., an abundant discharge of spores perfectly viable and able to germinate.

Under the conditions in which, as in the present case, the ascospores are the sole primary source of infecting the pear by *Myc. sentina*, the presence of an abundant quantity of viable ascospores is the first of essential circumstances which make 'seccume' epidemics possible. The other factors to which spring infection is subordinated are represented by the renewal of growth

by the host and climatic conditions practically shortened by a minimum of temperature and humidity below which the production of ascopores and their subsequent germination cannot occur.

As regards the growth renewal of the host, it is definite that there is no concordance between the maturation of the perithecia and the course of development of the pear-tree. Even the dehiscence of the asci depends, as is known, on a mechanism subordinate to the realization of ecological conditions completely foreign to the vegetative vicissitudes of the host plant.

From preliminary experiments carried out in the laboratory in relation to humidity and temperature requirements, it was found that to have a discharge of ripe ascospores, a relatively high humidity and a temperature not falling below 12° C. sufficed; conditions which easily occur in the open in Italy from May, consequently primary contamination of pear-trees may take place at any moment.

FIG. 5. — Detail of lesions bearing numerous perithecia of *Myc. sentina* springing up on wintered leaf (under surface) (original)

FIG. 6. — Cross section of young thallus of *Sept. piricola*, presenting conidia born on short conidiophores (× 450) (original)

Besides, I myself observed in Tuscany, during 1943, the presence of white fructified spots already on June 21, on pear-trees in the Casignano district, where official experiments against the downy mildew of the vine were being carried out, and also in 1945 I saw the first characteristic lesions of 'seccume' about June 15. In Calabria, on the contrary, in 1944, the same observation was only made in the first days of July probably owing to the delay in the development of the perithecial phase caused by a heavy fall of snow and by an exceptional period of low temperature even during the spring. And there is also the influence of the trend of infection during the preceding year and the time of leaf-fall, as the fragmentary surveys indicated.

The preliminary results of experiments, briefly reported in this first note confirm the great importance, if it is desired to limit and control effectively white spot of the pear-tree, of the biology of the pathogen. And this for the purpose of developing a system of control which will be based on epidemiological

study and not on empirical and approximate data usually derived chiefly from the trend of development of the host and not of the parasite, and incapable of improving the health conditions of our orchards.

In studying the maturation of perithecia, I realized that it would be necessary to develop a method for calling attention which would allow of pre-determining the first period of ascospore discharge under natural conditions. In effect, it appears evident that only this datum can suggest the right moment for the application of preventive treatments ; if these were effected before or after expulsion of the ascospores, they would be quite ineffective, as they would neither prevent nor even limit the occurrence of primary infection.

It is true that it would perhaps be useful in this respect to know the type of lesions of the leaves which remain through the winter and the macroscopic characteristics of the perithecia which appear in the spring on the surface of dead leaves. This would allow investigators to forecast with fair accuracy, once the small black points appear which on close examination are also visible to the naked eye, the imminent projection of the ascospores. This projection takes place as soon as suitable conditions of humidity and temperature occur. The method which I tried in studying *Venturia*, however, would be much more certain and positive. It consists in establishing guide foci with infected leaves, fallen to the ground in autumn and kept on the ground by means of a small metal grating opportunely applied. When the ripening period of the perithecia approaches, a certain number of small glass plates coated with glycerine set in special small cases fitted with a protective system are placed on the grating. There is thus the double advantage of protecting the plates from the action of external agents and of maintaining practically under the natural conditions of the orchard, the control leaves already wintered. Microscopic observations of the plates at ever briefer intervals make it possible to determine not only the period of the first projection of the ascospores, but also to learn the successive periods of emission in nature.

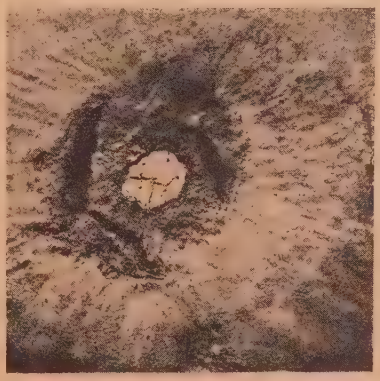

FIG. 7. — Detail of a white spot of *Sept. piricola* fructified, developed in the middle of a pear scab lesion (original)

From the criteria just expounded, it will be seen that the organization of an information and reporting bureau by the Royal Phytopathological Observatories in fruit-growing zones would be of great service to fruit-growers by advising them in time of really effective preventive treatments. In regard to these latter, stress should be laid on the necessity of putting forward, as a rule, the date of preventive treatments in consequence of the facts observed in the course of our investigation and because of the ecological conditions of the country. In Italy, these treatments should be given to pear-trees at the

beginning of June rather than during the first fortnight of July as is advised by FERRARIS, who evidently accepted the conclusions of KLEBAHN who, in two consecutive years of experiments, did not succeed in obtaining during the month May 'seccume' infection from ascospores, while the same experiments succeeded if they were effected towards the end of June.

The investigations relative to the saprophytic phase of *Myc. sentina* have shown chiefly the possibility of extending also to the pathogenic agent of this disease the principle of eradicant struggle introduced by the KEITT school in the United States to combat apple scab (*Venturia inaequalis* (Cooke) Wirt.).

Fuller details will be given in another note on the possibility of devising a program of eradicant control of pear scab and 'seccume fogliare estivo'.

A SERIOUS ATTACK OF RED SPIDER (*TETRANYCHUS TELARIUS*) ON CITRUS ALONG THE SORRENTO COAST *

A heavy attack of arachnids occurred in July, 1944 on citrus groves of the Sorrento coast; it caused very severe damage, particularly to lemon-trees.

The zone most seriously affected, where the trees were completely or in part defoliated, was that of the Sorrento commune itself, in the highest part of the territory cultivated to citrus over an area of approximately 200 hectares. This attack became particularly virulent in many zones of the commune of Massalubrense, while it produced lesser damage in the commune of Vico Equense.

I recognized the arachnid collected in large quantities from the leaves of lemon-trees as being *Tetranychus telarius* (L.) Duges, very common species on a large number of wild and cultivated plants. Nearly every year in summer, this species breeds in large numbers, causing appreciable damage especially to tomatoes, egg-plants, beans, etc. So far it had never developed to such an alarming extent on lemon-trees which, in this zone, constitute one of the chief basic crops.

This *Tetranychus* has been reported several times as being dangerous for lemon-trees in Southern Italy and particularly in Sicily, because to it are attributed, as well as to other arachnids and other causes, certain characteristic and common changes in the rind of the fruit, known as 'ruggine', 'ruggia', 'cannacca'.

* Communication of Dr. DOMENICO ROBERTI, transmitted to the International Institute of Agriculture by Prof. FILIPPO SILVESTRI, Director of the Royal Laboratory of Agricultural Entomology, Portici, Italy.

and 'naso di ferro', which greatly depreciate the value of the fruit. Boselli * in 1935, in a citrus grove at Minori on the Amalfi coast, observed this *Tetranychus* on lemon leaves, but the attack did not spread and ended in the first fortnight of July and did not cause any serious defoliation of the infected trees. I consider, therefore, that the case of Sorrento in 1944 is worthy of interest.

It is supposed that the probable cause of the rapid and extraordinary development of the *Tetranychus* at Sorrento was due to the heavy fall of volcanic sand which took place throughout the zone following the eruption of Vesuvius in the preceding March. It is very difficult, however, to ascertain if this fall of sand could, and in what way, have an influence on the trees rendering them more susceptible to attack, or if rather it stimulated breeding of the spider. Account should be taken of the fact that in other agricultural zones seriously hit by the eruption, we received no information of similar appearances of arachnids, and that this attack did not even extend to all the Sorrento coast. There is no doubt, however, that the particularly dry and arid season favoured the development of these attacks and prolonged their duration.

This *Tetranychus* formed more or less extensive colonies on the lower surface of the leaves and also attacked many of the fruits over all their surface.

The characteristic web of the parasite composed of very fine silk threads was easily visible on the leaves and underneath could be seen the reddish purple or reddish brown adult females, the males very small and pale greenish in colour, as well as the numerous larvae of the same colour as the males, but having only six legs. The eggs very numerous and perfectly spherical, varied in colour, according to the development of the embryo, from white-straw yellow to ocre yellow, were attached to the threads of the protective web or to the leaf by means of an adhesive substance with which they are coated.

Due to the punctures of the spider the leaves, on a more or less extensive area of the limb, had yellowed and had wrinkled slightly at different points or along the sides of the main nervure, so as to present, in correspondence with these spots, swellings, on the upper face. These zones were of a lemon colour on the upper surface, ocre yellow on the under surface on which could be seen the fine web which retained within its threads the remains of dead spiders and debris.

If the fruits attacked were still green, the part attacked was first yellowish in colour, becoming darker later. If the fruits were already dark in colour, they took on a greyish turning to sooty coloration which became ever more intense and darker.

The attack of *Tetranychus* on lemon-trees became extremely serious because infected leaves fell rapidly to the ground and total defoliation occurred in many groves in the zones we mentioned earlier on, and where the spider had completely invaded the trees. The fruits attacked dropped from the tree or stopped growing or else appeared greatly damaged. Although the principal summer crop

* Boselli, F. B. Su alcuni parassiti animali del limone in costiera amalfitana. *Il Picentino*, Salerno, 1935, anno 91, nn. 7-8, pp. 232-239.

was almost entirely saved, as attack only began towards the middle of July, many fruits, however, which were not yet fully developed and still on the tree in August, were lost. The anxiety of the growers was due particularly to the rapid and intensive defoliation of the trees which would affect the next crop.

The red spider attacked orange-trees only on the leaves, but not so severely as the lemon-trees. The infected leaves were not easily detached from the trees and consequently these resisted better and were less damaged. This resistance of the orange to red spider attack could also be seen in citrus groves where the lemon-trees were very severely invaded.

Among other plants attacked by this arachnid were noted the pumpkin, tomato, potato, egg-plant, beans and less seriously, cabbage. In some zones fig and peach trees were attacked while everywhere the vine and the walnut were free from attack. Among ornamental plants, roses were the most frequently infested.

The spread of this spider and its multiplication occurred with enormous and surprising rapidity. In August, at a temperature of 28-30° C., the eggs under observation took four days to hatch and several females isolated and kept under observation for three days, laid on an average six eggs per day. When the temperature dropped and the early rains came, there was a considerable diminution of the red spider and at the beginning of September, it was found to have disappeared from citrus leaves.

On citrus and other plants I noticed an appreciable development of insect predators of *Tetranychus*, and belonging to the folowing orders: Thysanoptera, Coleoptera, Necroptera, and Diptera. Their description, supplemented with biological data, will form the subject of a subsequent note. The activity of these predators was really considerable and particularly among them a small beetle (genus *Stethorus*) both in the larval and the adult stage. It was very active in destroying the eggs, larvae and adults of *Tetranychus*, but nevertheless this was not sufficient and recourse had to be had to artificial control which proved indispensable.

Unfortunately, the application of artificial control came up against many difficulties owing to the impossibility of finding on the market the substances considered the most effective against these arachnids. Thus, while recommending treatments with soapy solutions of tobacco extract to those who could procure the material, I endeavoured to orient control towards the general use of 3 per cent. aqueous solution of calcium polysulphide. I advocated using great care in preparing the solution and thorough spraying of all the foliage endeavouring to reach the under surface of the leaves where red spiders prefer to settle. This treatment which was carried out by different growers in Sorrento and Massalubrense and repeated after 10-12 days, proved more effective in destroying the spiders than plain dustings with sulphur. Some growers told me that they had noted a certain effect by ordinary washing of the plants with a strong jet of water.

In the control campaign, other plants, particularly herbaceous, cultivated or wild plants, were not forgotten; these were given suitable treatment or else dug under.

LEGISLATIVE AND ADMINISTRATIVE MEASURES

Belgium. — By Resolution of January 14, 1946, the custom-house at Kempen, Bocholt, has been opened for the import and export of horticultural plants other than the vine. (*Monituer belge*, Bruxelles, 19 janvier 1946, 116e année, nº 19, p. 473).

Italy. — By Legislative Decree of the Lieutenancy No. 806, dated November 23, 1945, a credit of 150,000,000 lire has been placed at the disposal of the Ministry of Agriculture and Forests to provide for requirements in regard to locust control. (*Gazzetta Ufficiale del Regno d'Italia*, Roma, 9 gennaio 1946, anno 87º, n. 7, p. 67).

French Morocco. — By Decree of August 4, 1945, the list of countries invaded by the Colorado beetle [*Leptinotarsa decemlineata*] is as follows : — French West Africa, Germany, Belgium, Bermuda, Canada, Spain, United States of America, United States of Brazil, United States of Mexico, France, Channel Islands, Italy, Luxemburg, The Netherlands, Portugal, Switzerland.

The list of countries bordering invaded countries for which the Colorado beetle has been reported at least 50 km. from their country is as follows : — Austria. (*La Terre Marocaine*, Casablanca, septembre 1945, 15e année, nº 190, pp. 22-23).

MATERIAL FOR AN EUROPEAN COLORADO BEETLE BIBLIOGRAPHY *

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* Assembled by GIULIO TRINCHIERI, International Institute of Agriculture.

† See this *Bulletin* 1945, Nos. 9-10, pp. 81-88; Nos. 11-12, pp. 109-112; 1946, Nos. 1-2, pp. 9-16.

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(To be continued).

NOTES

First International Congress of Phytopharmacy. — The Vlaamsche Chemische Vereeniging, scientific Association without pecuniary gain, is holding the 1st International Congress of International Phytopharmacy in September 1946 at the Agricultural Institute of the Louvain University, Héverlé, Belgium.

The object of the Congress is threefold : — (1) to ' take bearings ', that is to say, to ascertain as accurately as possible the progress of phytopharmaceutical science made in allied and neutral countries during the five years of war ; — (2) to be the new starting point for new achievements in the phytopharmceutical branch by giving investigators the opportunity of making known the results of their recent scientific researches ; — (3) to popularize present scientific knowledge in phytopharmacy.

The address of the permanent Secretariat of the Congress is : 20, rue Minckelers, Héverlé-Louvain, Belgium.

Prof. UGO PAPI, *General Secretary of the International Institute of Agriculture.*

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